

Singerman, Joel

From: Singerman, Joel
Sent: Monday, November 8, 2021 12:04 PM
To: Brown, Janet E (DEC); Eaton, Daniel J (DEC)
Cc: Doug; Tsiamis, Christos
Subject: Additional Information for Citizens
Attachments: Statement of Qualifications 5-20-2021.pdf; Fanwood ISGS Case Study.pdf; ISGS Technology Discussion_IET.pdf

This supplements my prior email. Additional information related to the ISGS technology is attached.



Innovative Environmental Technologies, Inc.



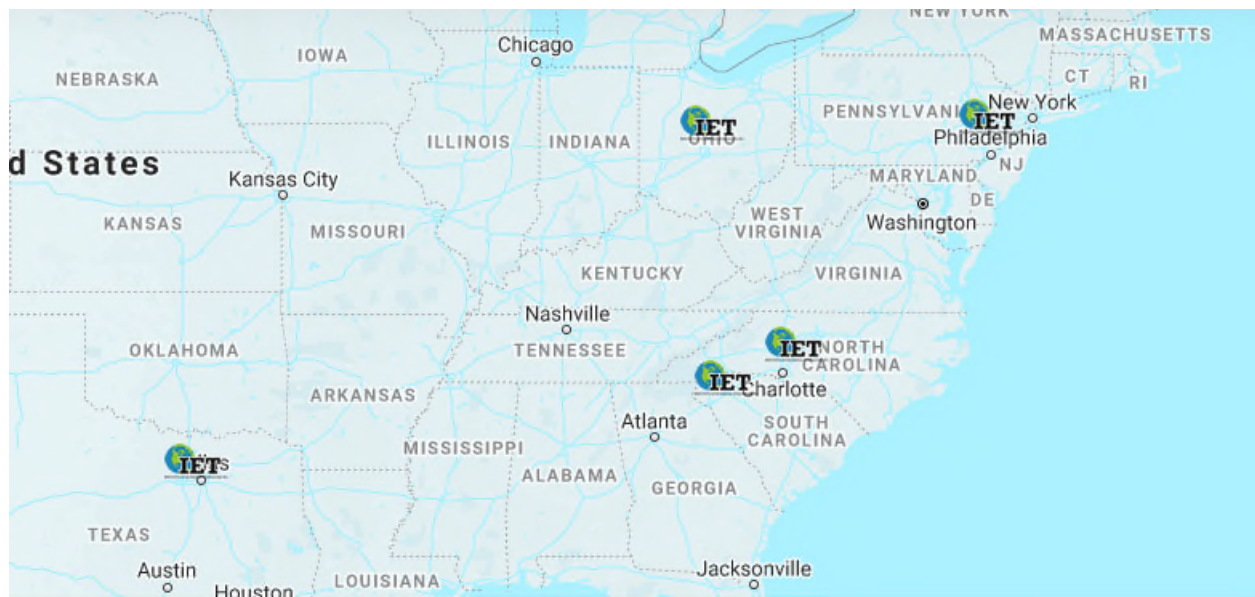
Updated May 2021

Innovative Environmental Technologies, Inc.

6071 Easton Road
Pipersville, PA 18947
(888) 721-8283
www.iet-inc.net

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Company Profile

IET is a turn-key remedial contractor and geotechnical/environmental drilling company providing in-situ chemical and biological injection services for over 22 years. IET personnel are comprised of microbiologists, chemists, engineers, geologists and experienced drillers that are able to design and implement remediation and drilling projects in a timely and cost-effective manner.

IET has designed and implemented over 1,800 remedial projects since its inception, including in-situ chemical oxidation injection, in-situ chemical reductive technologies, in-situ soil mixing, and ex-situ soil treatment.

IET was formed in 1998 in response to a need for a technology based remedial contractor without ties to any specific product vendor or consulting engineering company. Since its inception, IET has developed and patented in-house technologies where appropriate, licensed outside technologies when needed and worked with a variety of product vendors in its effort to offer its clients the best and most efficient remedial options.

IET has designed, fabricated and built equipment, tooling and remedial systems that integrate these technologies such that the consulting engineering companies we contract to are assured that they are providing their customers with appropriate and proven integrated remedial solutions. IET currently maintains five regional offices and conducts projects throughout the country.

In 2014 IET formed its environmental drilling division. In 2016 IET opened its North Carolina offices. In 2020 IET acquired the assets of A E Drilling, LLC, of Piedmont, South Carolina, establishing the drilling division as the largest and most diversified environmental drilling contractor in the southeast. In 2021 IET acquired GEDCO Drilling and Coring, Inc., in Irving, Texas, allowing the company to provide environmental and geotechnical drilling services in Texas and the surrounding Gulf States Region.

Office Locations

1 - IET Headquarters: 6071 Easton Road – Pipersville, PA 18947 (888) 721-8283 – Mike Scalzi, Justin Mariani
2 - Ohio Regional Office: 3958 North St. Rt. 3, Suite B – Sunbury, OH 43074 (740) 365-6100 – Wade Meese
3 - North Carolina Regional Office: 232 Highway 49 South – Concord, NC 28025 (704) 363-8663 – Mike Tynan, Matt Edmund
4 - South Carolina Regional Office: 30 Grant Park Place – Piedmont, SC 29673 (864) 979-8166 – Randy Phillips, Randall Cutter
5 – Texas Regional Office: 526 North Britain Rd, Irving, TX 75061 (864) 979-8166 – Lee Stoudenmire, Randy Phillips

Services Overview

Working with consulting engineering companies across the country, IET has successfully completed over 1,800 remedial projects. IET's patented enclosed injection trailers are capable of injecting a variety of oxidative and corrosive remedial materials with all stainless-steel piping. The injection trailers are capable of injecting chemical oxidants at pressures between 50 and 1,000 psi, depending on geology (lower pressure in sands and higher pressures in bedrock).

Although IET is not an environmental consulting company – we serve the consulting industry, providing the field experience and resources to safely implement projects utilizing innovative and emerging technologies. IET is the resource that enables you to provide to your client's technology and cost comparisons. IET actively researches and tests new treatment methods in order to stay current with your remediation needs. This mentality has fueled our growth and success in the environmental contracting and consulting fields. Initial evaluation, environmental drilling, tailored remedial designs, implementation and post project data evaluation are all services that IET regularly provides with our team of renowned experts.

Remedial Design and Implementation Capabilities

IET supports its clients in the design and implementation of in-situ remediation programs that include injection and soil mixing.

Contaminate Expertise

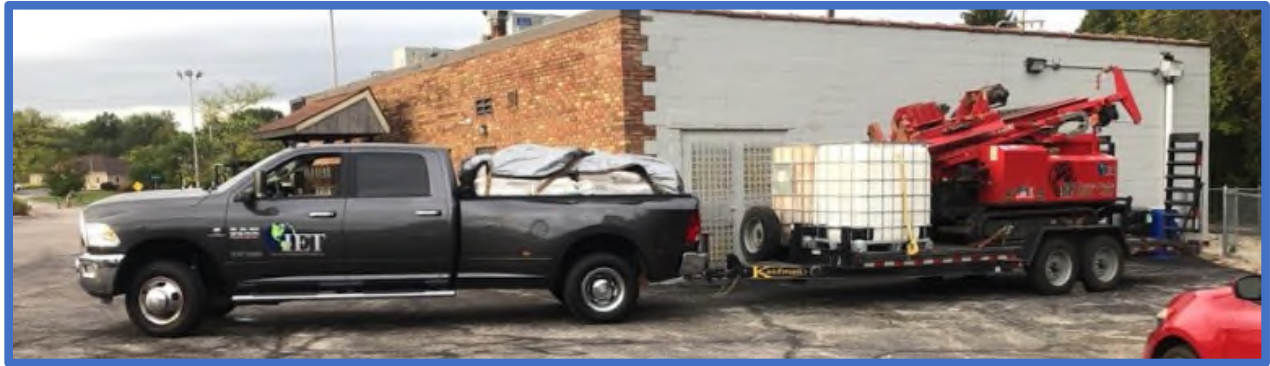
- Chlorinated Solvents
- Heavy Metals
- Petroleum Compounds
- Pesticides
- Creosote/Coal Tars/MGP Waste

IET can facilitate and support laboratory bench testing in-house at our technology center as well as through neutral 3rd party treatability labs.



Direct Push Amendment Injection

- Chemical Oxidants such as: Permanganate, Persulfate, Fenton's Reactions
- Zero Valent Iron/In-Situ Chemical Reduction (ISCR) Substrates
- Abiotic and Biotic Reductive Dechlorination Materials
- Bacteria such as Liquid Petroleum Degrading Cultures
- PAH Stabilization Agents
- Emulsified Oil Technologies such as EZVI
- Slurries of up to 40% Solids
- Geochemical Stabilization Technologies (ISGS)



Drilling Services, Injection Services, and Equipment

Drilling Services

- Steam Cleaning
- Largest Fleet of AMS PowerProbe Rigs in the World
- Multiple Drilling Licenses Nationwide
- Auger Drilling and Split Spoon Sampling up to 18" OD to 200 ft
- Soil Coring 3" and 4" to 200 ft
- Mud Rotary Drilling up to 12" OD to 2,000 ft
- Air Rotary Drilling to 1,000 ft
- "Punch" Soil Coring to 1,000 ft
- Undisturbed Soil Sampling
- In-Situ Packer Testing with Data Logging Pressure Testing
- Soft Dig Services
- Remediation Amendment Design and Injection Services
- Marine Drilling Services
- Limited Access Drilling and Soil Sampling
- Cathodic Protection Well Install
- Level A, B, C and D Health & Safety Protocols
- Well Development and Pump Test Management
- Bore Hole and Well Video Services
- All Terrain Drilling
- Angled Drilling Capabilities





Drilling Equipment

- 1 - 2015 Mobile B-57 Track Rig
- 1 - 2007 Schramm T-450T Truck Rig
- 1 - 2011 CME 550-X High Torque ATV Rig
- 1 - 2004 CME 750-X High Torque ATV Rig
- 1 - 1976 CME 45C
- 3 - CME 75s- ATVs and Truck Mounted
- 1 – CME 55
- 1 – CME 850 Track Rig
- 1 – Garden Denver 1000 Truck Mounted Rig
- 1 - 2004 Geoprobe 6610DT
- 1 - 2008 Geoprobe 8040DT
- 1 - 2014 Geoprobe 7822DT
- 1 - 2005 Geoprobe 6610 Truck Mount
- 1 - 2003 AMS 9630 P (Portable Rig)
- 1 - 2006 AMS 9635 VTR
- 1 - 2006 AMS 9500 VTR
- 2 - 2011 AMS 9500 VTR
- 1 - 2014 AMS 9510 VTR
- 1 - 2016 AMS 9520 VTR
- 1 - 2017 AMS 9580 VTR
- 1 - 2005 Vactron Trailer
- 1 - 2007 Morooka MST-800
- 3 - International Tractor Trailers
- 1- Peterbuilt Road Tractor
- 5 - Decontamination Trailers
- 4 - Amendment Mixing and Injection Systems (Patented)
- 2 - Barges
- 4 - Fork Trucks
- 5 - Skid Steer Loaders
- 48 - Support Trucks
- 16 - Support Trailers
- 2 - “Low-Boy” Trailers
- 1 – Larger Barge
- 1 – Small Barge



Injection Services

IET Self-Contained Injection Systems are designed and assembled in-house to ensure compatibility with any type of remediation compound (Oxidants, 30 w/w slurries, low/high pH compounds, etc.). The injection trailer systems include the following:

Self-Contained Mobile Injection Units

- Onboard Air compressor (175 psi, 25 cfm)
- Onboard 10 kw diesel generator
- Air-Conditioned Office Space
- All Piping Tig Welded 316-Stainless Steel Construction
- Onboard Pressurized Safety Shower and Eye Wash Station
- Liquid Overflow Protection
- Gas Pressure Relief Valves
- 2 – 150 gal Conical Mixing Tanks
- 2 – 3/4" hP Angled Lightning Mixers with Dual Impellers
- 1 – 250 gal Bulk Water Storage Tank
- 1 – 20 gal Pressurized Injection Tank
- 240 gal Capacity Compressed Air/Gas Storage
- Secondary Containment Pad
- Chemical Resistant Injection Hoses with Stainless Steel Fittings and Viton Seals



Soil Mixing Services

When a site is unsuitable for in-situ remedial material injection due to the high contamination present in the shallow, unsaturated zone, soil mixing can be employed to quickly reduce concentrations to below hazardous waste standards. The most common application of soil mixing is when soils are above HAZ disposal limit and need to be reduced to minimize costs to the client for soil disposal.



Intellectual Property

IET's experience and innovation has led to 14 United States Patents and Applications Pending covering injection methods and novel oxidation and reductive dechlorination technologies. Over the past 19 years, IET has developed and successfully implemented a multitude of both physical delivery techniques and chemical remediation technologies (ISCR, ISCO, Stabilization, Metals Precipitation, Encapsulation, Methane Inhibition, Biostimulation, Bioaugmentation, etc.) These technologies have been implemented safely and effectively in over 30 states across the United States as well as internationally.

PATENTS

IET has focused on in house intellectual property and licensed proprietary technologies. Today, IET is recognized as a leader in in situ remediation technologies.

IET Owned Patents – Issued:

PAT. NO.	Title
1 <u>9,637,731</u>	<u>Heavy metal stabilization and methane inhibition during induced or naturally occurring reducing conditions in contaminated media</u>
2 <u>9,427,786</u>	<u>Chemical oxidation and biological attenuation process for the treatment of contaminated media</u>
3 <u>9,221,699</u>	<u>Inhibition of methane production during anaerobic reductive dechlorination</u>
4 <u>9,126,245</u>	<u>Chemical oxidation and biological attenuation process for the treatment of contaminated media</u>
5 <u>9,126,244</u>	<u>Use of encapsulated substrates that control the release rates of organic hydrogen donors</u>
6 <u>8,766,030</u>	<u>Utilization of ferric ammonium citrate for in situ remediation of chlorinated solvents</u>
7 <u>8,147,694</u>	<u>Method for the treatment of ground water and soils using mixtures of seaweed and kelp</u>
8 <u>7,828,974</u>	<u>Method for the treatment of ground water and soils using dried algae and other dried mixtures</u>
9 <u>7,531,709</u>	<u>Method for accelerated dechlorination of matter</u>
10 <u>7,129,388</u>	<u>Method for accelerated dechlorination of matter</u>
11 <u>7,044,152</u>	<u>Apparatus for in-situ remediation using a closed delivery system</u>

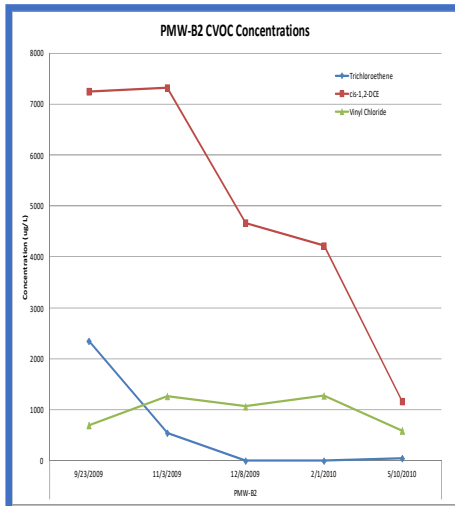
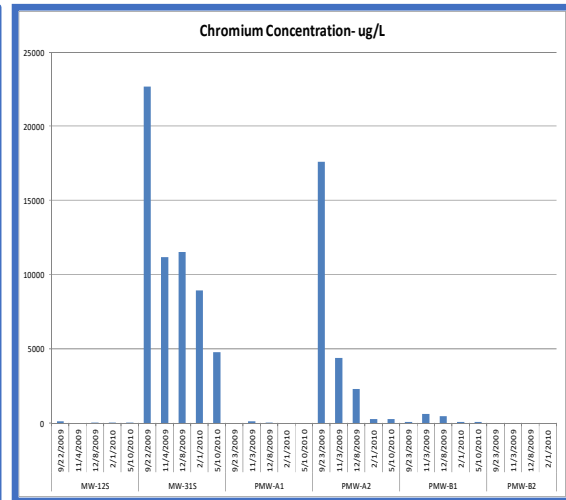
IET Owned Patents – Pending:

PUB. APP. NO.	Title
1 <u>20190256390</u>	<u>USE OF ENCAPSULATED SUBSTRATES TO CONTROL RELEASE RATES OF ZERO VALENT METALS</u>
2 <u>20180093308</u>	<u>METHANOGENESIS CONTROL DURING ENVIRONMENTAL APPLICATIONS USING ANTIMETHANOGENIC REAGENTS</u>
3 <u>20180001358</u>	<u>INHIBITION OF METHANOGENESIS IN REDUCING ENVIRONMENTS</u>
4 <u>20170239699</u>	<u>Chemical Oxidation and Biological Attenuation Process for the Treatment of Contaminated Media</u>



Case Study

- **Cleveland Flats Development Project – Reductive Dechlorination of Solvents**
 - Contaminated soil and groundwater by trichloroethene (TCE), cis-1,2-dichloroethene (cis-1,2-DCE), vinyl chloride, and hexavalent chromium
 - 70 in-situ injections of compressed nitrogen and a solution of EHC-M, calcium propionate, and an oxygen scavenger
 - Over 8 months, TCE concentrations decreased by 98%, the site was closed, and development had begun shortly after



- **Fanwood, NJ – Implementation of In-Situ Geochemical Stabilization (ISGS)**

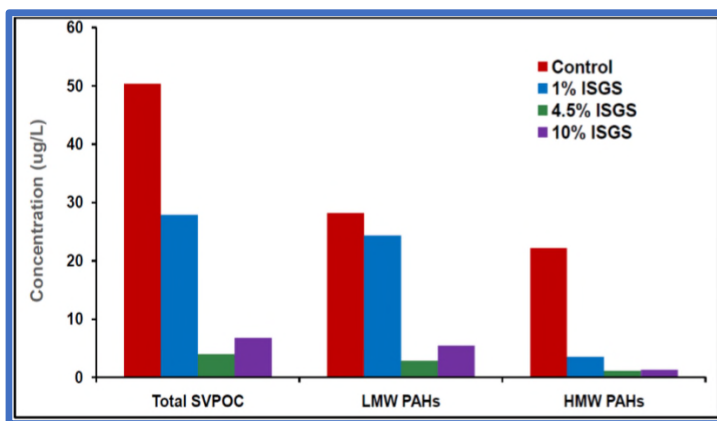
- IET is an exclusive licensee for ISGS technology
- Technology is supported by Regions 4 and 8 of the EPA



- Stabilization of DNAPL
 - Chlorinated Solvents
 - PCB's
 - Coal Tar
 - Creosotes
 - PAH's

- Sources of DNAPL

- Metal Cleaning and Degreasing
- Manufacturing Operations
- Dry Cleaning Operations
- Military Bases
- Fuel, Solvent, Paint, and Ink Production
- Pesticide/Herbicide Manufacturing
- Timber Treatment



Well ID	Thickness of Free Product (feet)					
	05/25/2012	06/07/2012	03/14/2013	10/16/13	10/18/13	01/15/14
TW-1/MW-14	4.16	3.90	4.24	ND	ND	ND
TW-2/MW-15	5.34	4.98	5.31	ND	ND	ND
TW-3/MW-11	5.26	5.12	5.37	ND	ND	ND
TW-5/MW-12	5.60	4.99	4.64	ND	ND	ND
TW-8/MW-13	3.43	3.07	3.26	ND	ND	ND

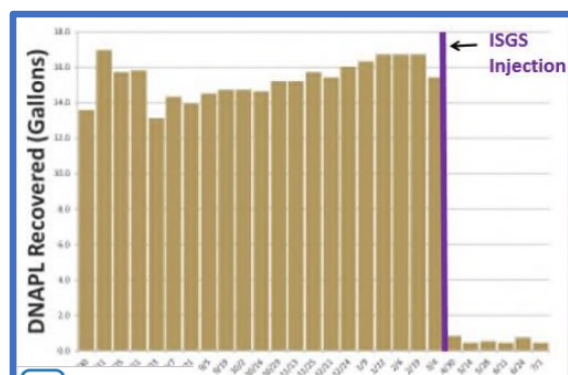
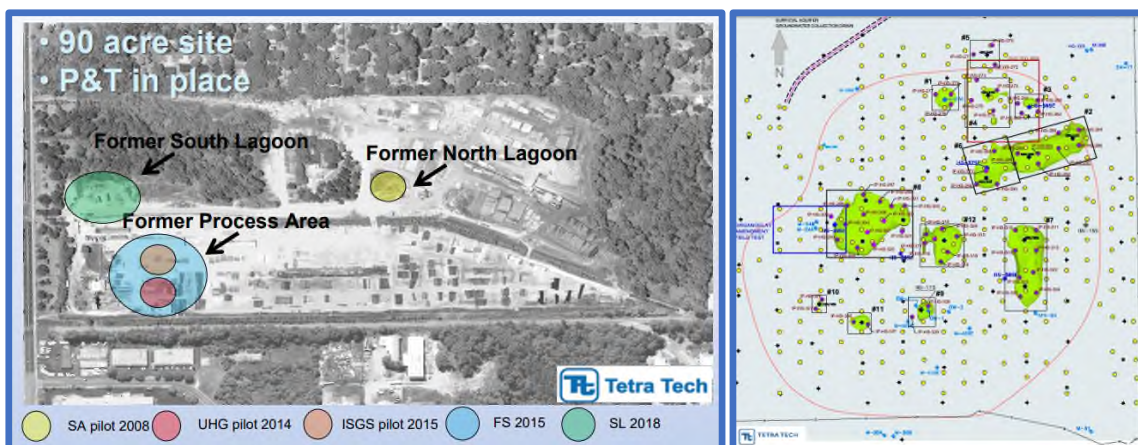
Station Square at Fanwood, NJ



Convert contaminated ground deemed unusable into flourishing businesses and housing with the help and expertise of IET.



- Cabot Koppers Superfund Site, Gainesville FL – ISGS Injections for DNAPL
 - Historically, the site was a timber treatment site utilizing creosote
 - Creosote = DNAPL (Dense, Non-Aqueous Phase Liquid)
 - Almost 200,000 gallons of ISGS reagent injected over 267 injection points
 - Historic low DNAPL concentrations recorded after injection event
 - This method designed and implemented by IET was the best technique considering cost and effectiveness

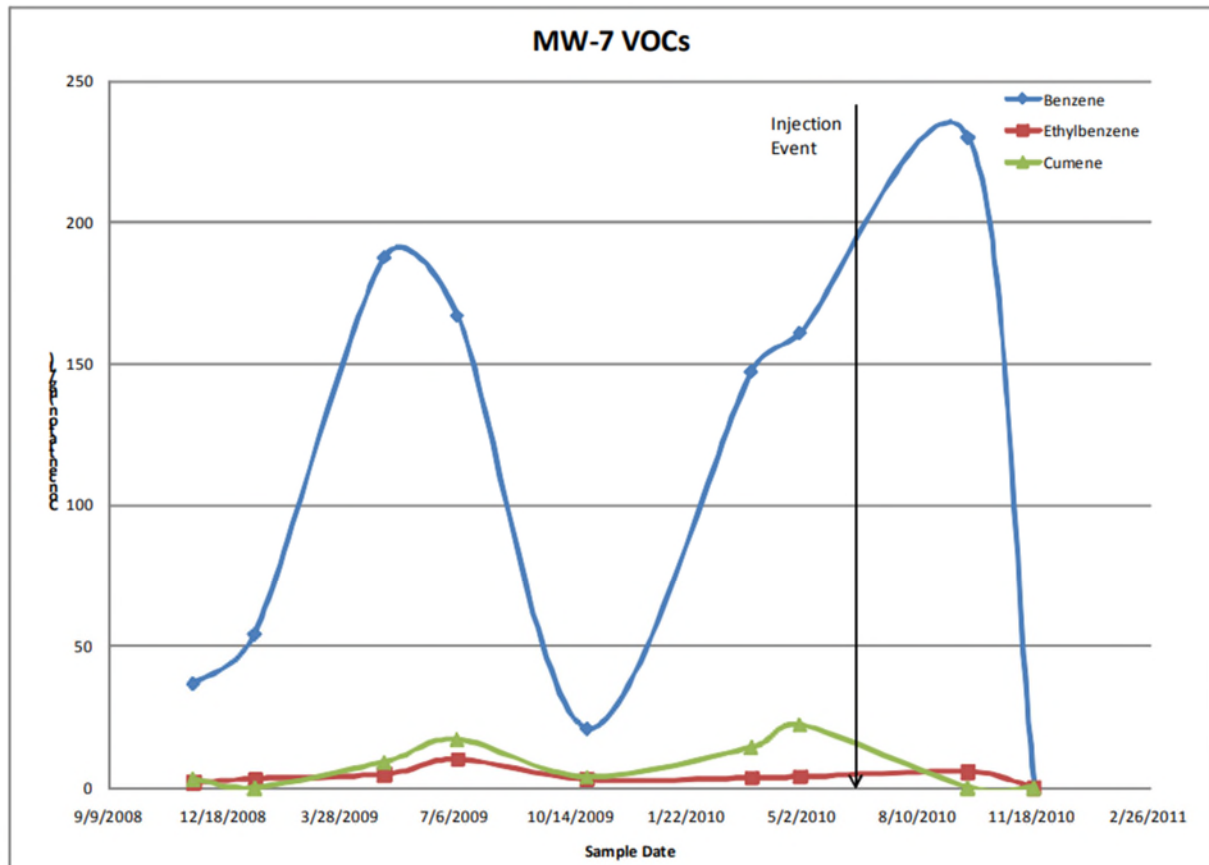


Targeted-Approach Cost Savings

Treat Entire Footprint (5-67 ft bgs)	\$10.5M
Targeted DNAPL Impacts (Actual)	<u>\$ 2.5M*</u>
Cost Savings	<u>\$ 8.0M</u>

* Costs Include Characterization, Pilot Test and Full-Scale Treatment

- **Former Gasoline Terminal in Erie, PA - Chemical Oxidation of Free Products**
 - Historic petroleum spills that led to free product contaminating the groundwater and soil
 - Contaminated by BTEX (Benzene, Toluene, Ethylbenzene, Xylene, and Cumene)
 - Combination of Sodium Persulfate and Hydrogen Peroxide, activated by Zero Valent Iron was injected into 70 injection points
 - Remedial approach utilized free radical chemistry, oxidation chemistry and facultative biological oxidation in such a way as to extend the oxidant and free radical residuals while enhancing the in-situ environment such that it is suitable for biologically based attenuation
 - Six months after injection event, levels had been reduced below statewide health standards and no free product was present



Key Staff Assignments

Michael Scalzi, President - mikescalz@iet-inc.net

Mr. Scalzi, President and founder of Innovative Environmental Technologies, Inc. (IET), has been performing biologically and chemically based remediation since the late 1980's. Mr. Scalzi designed and implemented projects that have ranged in scope from large scale, such as a 136,000-cubic yard in-situ soil remediation in New Jersey, to small scale, such as a 2,000 cubic yard in-situ injection program at a strip mall dry-cleaner in Tennessee. In the nearly 20 years he has been performing remedial projects, he has designed, implemented, and patented chemical, biological and mechanical processes.

Mr. Scalzi holds a Master's degree in microbiology from the State University of New York. He has also participated in the curriculum development for environmental profession programs, sat on numerous state and federal roundtables and advisory boards, developed curriculum for college programs in New York and Pennsylvania, holds patents in delivery and remedial processes, and has published numerous articles relating to his experiences and expertise.

Wade Meese, Vice President - wademeese@iet-inc.net

Mr. Meese is the Vice President of IET. He has been performing biologically and chemically based remediation since the mid 1990's. His unique perspective relating to the integration of mixed technologies and delivery processes has allowed him to apply chemical oxidation, aerobic processes and anaerobic processes along with more traditional remedial approaches resulting in cost savings to his customers. Mr. Meese has applied a variety of remedial technologies to over 300 sites across the country. Included in these projects are over fifty petroleum facilities in Ohio, Illinois, Indiana, Tennessee, New Jersey, New York, California and Pennsylvania.

Mr. Meese holds a bachelor's degree in geology from The Ohio State University, holds patents in delivery and remedial processes, and has published numerous articles relating to his experiences and expertise.

Ian Connor, Vice President of Operations - ianconnor@iet-inc.net

Mr. Connor, Vice President of Operations, has been with IET since 2008. Mr. Connor holds a BS in Biology from Mansfield and has performed post graduate work at Villanova in Environmental Engineering. Mr. Connor has managed and overseen over 100 remedial projects over the past ten years and has implemented a variety of remedial technologies ranging from in-situ reductive dechlorination via both abiotic and biotic technologies, in-situ and ex-situ chemical oxidation, NAPL stabilization, and metal stabilization in sites across the USA.

Justin Mariani, Vice President of Field Operations - justinmariani@iet-inc.net

Mr. Mariani, Vice President of Field Services, has been with IET since 2011. Mr. Mariani holds a BS in Environmental Engineering from North Carolina State University. Mr. Mariani has managed and overseen over 85 remedial projects over the past 9 years dealing with environmental drilling, geotechnical drilling, and a variety of groundwater and soil remediation projects across the United States.

Randy Phillips, Vice President of Drilling Operations – randyphillips@iet-inc.net

Mr. Phillips, South Carolina Operations Manager, has joined IET at the beginning of 2020 with the acquisition of the South Carolina Branch. Mr. Phillips has been working in the drilling industry since 1983 with projects ranging from environmental and geotechnical drilling, to residential and commercial water well systems, and to mineral exploration. Mr. Phillips has been managing multiple crews in the Southeastern portion of the United States for the over 20 years.

Mike Tynan, North Carolina Operations Manager – mike.tynan@iet-inc.net

Mr. Tynan, Southeast Drilling Manager, has been with IET since the start of 2016 and will be operating out of Concord, NC at one of IET's newer facilities. Mr. Tynan holds a BS in Earth Science and Geography from the University of North Carolina at Charlotte. Mr. Tynan has managed and overseen hundreds of projects over the past 25 years dealing with environmental drilling, geotechnical drilling, and a variety of groundwater and soil remediation projects across the United States.

Health & Safety

IET takes pride in our outstanding safety culture and we are firmly committed to assuring a safe work environment for our employees, our clients, and the general public. Since formation in 1998, IET has designed and implemented over 1,500 injection-based remedial projects without a single reportable safety incident. IET for 2015-16 maintains an Experience Modification Rating (EMR) of 0.83.

All IET employees are 40-hour HAZWOPER trained and maintain current 8-hour refresher training in accordance with 29 CFR 110.120(e). Selected personnel also have 8-hour Hazardous Waste Supervisor training [29 CFR 1910.120(e)(4)] and maintain current First Aid/CPR certifications as well as various other certifications required by major oil and chemical refineries.

Our people make the difference and we mentor, train and provide the tools and resources which allow the IET Team the unique ability to proactively assess and implement solid and practical solutions to meet the ever-changing safety needs of our client base.



Insurance

General/Pollution Liability

Insurer:	Century Surety Company A.M. Best Rating: A- X
Coverage:	Environmental Combined Policy
Policy Limits:	\$2,000,000 General Aggregate Limit \$1,000,000 Each Occurrence – CGL \$2,000,000 Products/Completed Operations Aggregate Limit \$1,000,000 Personal & Advertising Injury Limit \$100,000 Damage to Rented Premises \$5,000 Medical Payments \$1,000,000 Contractors Pollution
Deductible:	\$10,000 Per Occurrence \$10,000 Per Pollution Condition

Commercial Auto

Insurer:	Star Insurance Company A.M. Best Rating: A- X		
Coverage:	Commercial Auto		
Policy Limits:	Liability:	\$1,000,000	Symbol 7,8,9
	Personal Injury Protection (or equivalent No-Fault coverage)	Statutory	Symbol 5
	Hired and Non-owned Liability	\$1,000,000	Symbol 8,9
	Uninsured/Underinsured Motorists	\$1,000,000	Symbol 2
	Physical Damage – Towing & Labor	\$50 per Disablement	Symbol 2

Excess Liability

Insurer:	Century Surety Company A.M. Best Rating: A- X
Coverage:	Excess Liability
Policy Limits:	\$5,000,000 Each Occurrence \$5,000,000 Products Aggregate Limit \$5,000,000 General Aggregate

Project Summary

In-Situ Geochemical Stabilization (ISGS) was utilized at a site located near Fanwood, New Jersey to remediate soils and groundwater impacted by the historical release of coal tars and heavy ended petroleum compounds. The compounds of concern included benzene, Benzo(a)anthracene, Benzo(a)pyrene, and multiple other VOC and SVOC contaminants. The in-situ program covered a total area of 8,955 square feet and treated soil and groundwater from 5-10 ft. below ground surface. The remedial liquids were injected into 44 points via direct push technologies (Fig.1). Two intervals between from 5-7 and 8-10 feet below ground surface (bgs) were used to inject the liquids into the targeted media affecting a radius of 7.5 feet for each point.

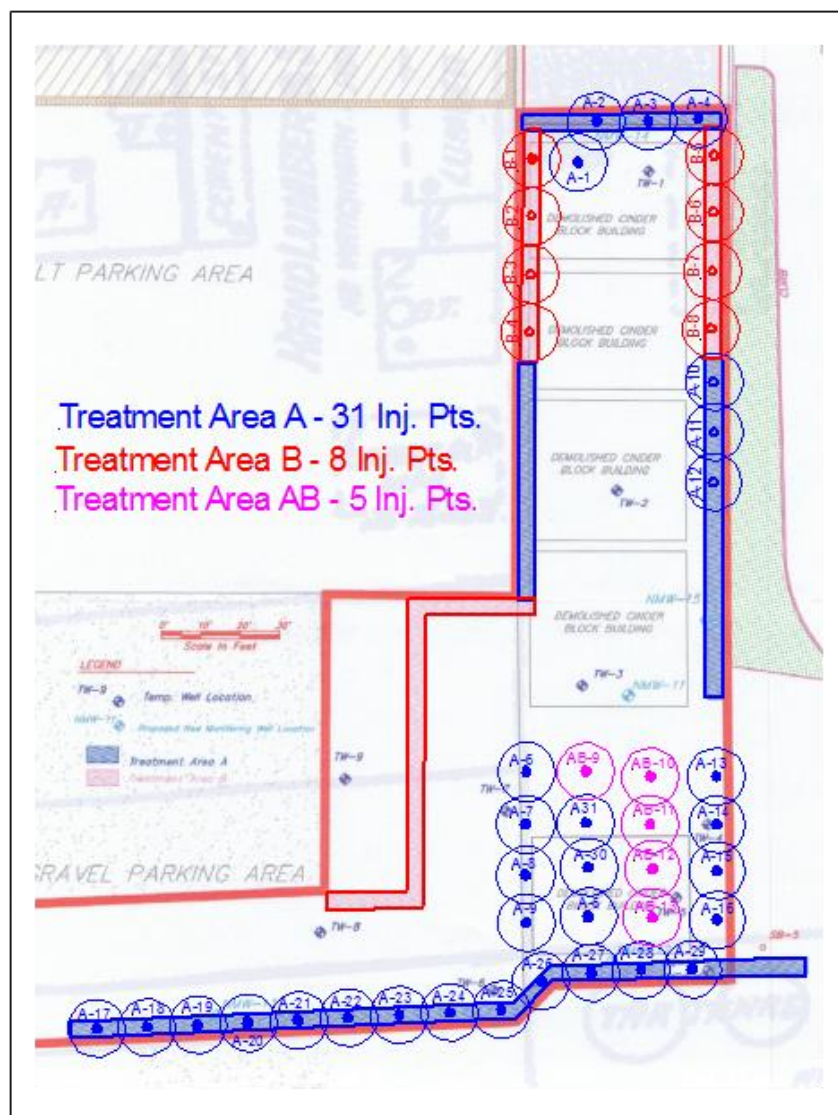


Figure 1. Site map showing the location of 44 in-situ injection points.

Remediation Plan

In-Situ Geochemical Stabilization (ISGS) entails the use of modified permanganate solutions for the purposes of mass removal and flux reduction (i.e., NAPL stabilization). As the oxidant migrates through the treatment area, various (bio)geochemical reactions destroy the targeted compounds present in the dissolved phase. This causes a “hardening” or “chemical weathering” of the NAPL as it steadily loses its more labile components. This causes a net increase in viscosity of the organic material, which yields a more stable, recalcitrant residual mass. In addition, both the insoluble MnO_2 precipitate that results from permanganate oxidation and other mineral species included in the ISGS formulation accumulate along the NAPL interface, physically coating the NAPL and thereby reducing the flux of dissolved-phase constituents of interest (COI) into the groundwater.

Unlike the typical application of In Situ Chemical Oxidation (ISCO) reagents, ISGS is used to encapsulate NAPL, with chemical oxidation of COIs being a secondary affect. As a result, the overall oxidant dosing is often substantially less than with typical ISCO applications, resulting in rapid, highly effective treatment at a much lower cost.

Results

Monitoring Wells

Five monitoring wells were sampled during the baseline sampling event of August 2013 and the first two post-injection sampling events. These wells are: MW-11, MW-12, MW-13, MW-14 and MW-15. The locations of the five monitoring wells are presented in the map below.



MW-11

Monitoring well MW-11 is located in the center of the main treatment area, where the demolition of the main building occurred. Based on the analytical data of the January 2014 sampling event, it appears that the remedial treatment event has dramatically impacted the concentrations of all targeted contaminants in the vicinity of monitoring well MW-11. The concentrations of almost all SVOC compounds have decreased to levels below the laboratory detection limits, while the total concentrations of the BTEX contaminants has decreased by 85%. The concentration of the total alkanes has also reached non-detect levels.

Table 1. CVOC Data for MW-11 (µg/L).

MW-11			
Sampling Date	08/30/2013	10/16/2013	01/15/2014
Acenaphthylene	0.461	0.312	ND 0.10
Benzo(a)anthracene	0.255	0.847	0.146
Benzo(a)pyrene	0.172	0.54	ND 0.10
Benzo(b)fluoranthene	0.218	0.76	ND 0.10
Chrysene	0.166	0.508	ND 0.10
Fluorene	0.791	0.314	0.239
Benzene	67.5	8.4	14.4
Ethylbenzene	6.6	ND 5.0	0.77 J
Toluene	46.5	ND 5.0	3.0
Total Xylenes	19.1	ND 5.0	2.7
Total Alkanes	63 J	ND	ND

ND: Not Detected

MW-12

Monitoring well MW-12 is located in the vicinity of injection points A-27 and A-28 in the southern part of the targeted treatment area. Based on the analytical groundwater data of the January 2014 sampling event, it appears that the remedial treatment event had a significant effect in the concentrations of the targeted SVOCs and VOCs. The concentrations of the SVOCs decreased significantly and reached levels below the laboratory detection in most occasions. Benzo(a)anthracene, Benzo(a)pyrene and Benzo(b)fluoranthene that recorded highly elevated concentrations during the August 2013 baseline sampling events have shown decreases of 93%, 96% and 95% respectively. Similarly the effect of the remedial injection was substantial for the concentrations of VOC compounds, with total alkanes decreasing below the laboratory detection limits and BTEX compounds overall decreasing by 68%.

Table 2. CVOC Data for MW-12 (µg/L).

MW-12			
Sampling Date	08/30/2013	10/16/2013	01/15/2014
Acenaphthylene	1.75	ND 0.10	0.151
Benzo(a)anthracene	5.13	0.44	0.385
Benzo(a)pyrene	6.31	0.162	0.248
Benzo(b)fluoranthene	6.30	0.222	0.292
Chrysene	5.15	0.224	0.261
Bis(2-Ethylhexyl)phthalate	5.80	ND 2.0	ND 2.0
Ideno(1,2,3-cd)pyrene	3.80	ND 0.10	0.105
Benzene	10.2	8.2	11.1
Ethylbenzene	3.8	1.6	0.51 J
Toluene	8.4	1.8	ND 2.0
Total Xylenes	22.4	7.3	2.8
Total Alkanes	412.4 J	ND	ND

ND: Not Detected

MW-13

Monitoring well MW-13 is located in the vicinity of injection points A-19 and A-20 in the southwestern part of the targeted treatment area. Based on the analytical data the injection event of September 2013 had a significant impact in the concentrations of all targeted SVOC compounds. Benzo(a)anthracene, Benzo(a)pyrene and Benzo(b)fluoranthene recorded decreases of 77%, 89% and 90% respectively compared to their August 2013 baseline sampling values, while naphthalene was the compound that was massively affected with the concentration decreasing from 1,920 µg/L in August 2013 to 1.18 µg/L in January 2014. BTEX concentrations appear to have slightly spiked during the January 2014 sampling event; however it is expected that they will decrease during the upcoming sampling event.

Table 3. CVOC Data for MW-13 (µg/L).

MW-13			
Sampling Date	08/30/2013	10/16/2013	01/15/2014
Acenaphthylene	81.3	11.6	0.64
Benzo(a)anthracene	2.92	0.435	0.684
Benzo(a)pyrene	1.75	ND 0.10	0.192
Benzo(b)fluoranthene	2.24	ND 0.10	0.233
Benzo(g,h,i)perylene	0.698	ND 0.10	ND 0.10
Benzo(k)fluoranthene	0.895	ND 0.10	0.121
Chrysene	2.02	0.235	0.409
Naphthalene	1,920	187	1.18
Benzene	100	48.7	175
Ethylbenzene	43.4	10.4	61.9
Toluene	160	24.4	161
Total Xylenes	179	41.6	171
Total Alkanes	3,625 J	ND	ND

ND: Not Detected

MW-14

Monitoring well MW-14 is located in the northern part of the targeted treatment area in the vicinity of injection points A-2 and A-3. Monitoring well MW-14 did not record elevated SVOC and VOC concentrations during the baseline sampling event with the exception of diethyl phthalate, benzene, ethylbenzene and toluene. During the 120-day post-injection sampling event the concentrations of the aforementioned compounds have all decreased to levels below the laboratory detection limits except for benzene that decreased by 43%.

Table 4. CVOC Data for MW-14 (µg/L).

MW-14			
Sampling Date	08/30/2013	10/16/2013	01/15/2014
Diethyl phthalate	7.2	-	ND 2.0
Benzene	8.1	7.1	4.6
Ethylbenzene	61.9	ND	ND 5.0
Toluene	2.0	ND 5.0	ND 1.0
Total Xylenes	ND	ND 5.0	ND 1.0
Total Alkanes	6.3 J	ND	ND

ND: Not Detected

MW-15

Monitoring well MW-15 is located in the center of the main treatment area, where the demolition of the main building occurred. Based on the analytical SVOC data of the January 2014 sampling event, it appears that the remedial treatment event has dramatically impacted the concentrations of all targeted contaminants in the vicinity of monitoring well MW-15. The concentrations of almost every SVOC compound have decreased to levels below the laboratory detection limits, while the concentrations of the BTEX contaminants that were significantly low during the baseline sampling event have also reached levels below the laboratory detection limits.

Table 5. CVOC Data for MW-15 (µg/L).

MW-15			
Sampling Date	08/30/2013	10/16/2013	01/15/2014
Acenaphthylene	0.197	ND 0.11	ND 0.10
Benzo(a)anthracene	0.459	ND 0.11	0.153
Benzo(a)pyrene	0.497	ND 0.11	ND 0.10
Benzo(b)fluoranthene	0.607	ND 0.11	ND 0.10
Chrysene	0.397	ND 0.11	ND 0.10
Naphthalene	0.453	0.541	ND 0.10
Benzene	0.31 J	0.52 J	ND 1.0
Ethylbenzene	ND	ND 1.0	ND 1.0
Toluene	0.58 J	ND 1.0	ND 1.0
Total Xylenes	0.62 J	ND 1.0	ND 1.0
Total Alkanes	5.4 J	ND 1.0	ND 1.0

ND: Not Detected

Free Product Data

Ten different wells were sampled before the implementation of the remedial injection event of September 2013 and the depth of the free product that was present in each well was measured. As Table 6 shows all ten wells appear to have elevated free product levels during the March 2013 baseline sampling event that ranged from 1.22 ft to 5.37 ft.

Table 6. Injection Thickness of Free Product (ft).

Well ID	Sampling Date					
	05/25/2012	06/07/2012	03/14/2013	10/16/13	10/18/13	1/15/14
TW-1/MW-14	4.16	3.90	4.24	ND	ND	ND
TW-2/MW-15	5.34	4.98	5.31	ND	ND	ND
TW-3/MW-11	5.26	5.12	5.37	ND	ND	ND
TW-4	5.35	5.02	5.11			
TW-5/MW-12	5.60	4.99	4.64	ND	ND	ND
TW-6	4.06	4.02	3.75			
TW-7	5.31	5.08	5.11			
TW-8/MW-13	3.43	3.07	3.26	ND	ND	ND
TW-9	1.15	1.14	1.22			
TW-10	5.02	5.09	4.16			

Five monitoring wells were sampled upon the completion of the injection event to address the effect of the remedial injection in the free product that was present in the subsurface. These wells are MW-11, MW-12, MW-13, MW-14 and MW-15.

Monitoring well MW-11 is closely located (within a few feet) from monitoring point TW-3 that recorded free product thickness of 5.37 ft in March 2013, in the area where the demolished Cinder Block Building is located. Based on the January 2014 sampling event no free product was detected in MW-11.

Monitoring well MW-12 is located in the vicinity of targeted treatment area A and more specifically close to injection points A-27 and A-28. Monitoring well TW-5 that recorded a free product thickness of 4.64 ft is also located in the same area. As the data from the last sampling event indicates the ISGS solution was very effective in treating the existing contamination since no free product was detected in MW-12.

Monitoring well MW-13 is also located in the vicinity of targeted treatment area A and more specifically close to injection points A-19 and A-20. Monitoring well TW-8 that recorded a free product thickness of 3.26 ft is located relatively close to MW-13. Based on the January 2014 data the ISGS solution was found effective in treating the targeted contamination since no free product was detected in MW-13.

Monitoring well MW-14 is located in the northern part of the targeted treatment area in the vicinity of injection points A-2 and A-3 very close to monitoring point TW-1. The thickness of free product in TW-1 was measured at 4.24 ft; however upon the completion of the remedial design no free product was detected in monitoring well MW-14.



Monitoring well MW-15 is located in the center of the main treatment area, where the demolition of the main building occurred, close to monitoring points MW-11, TW-2 and TW-3. Monitoring points TW-2 and TW-3 recorded free product thickness of 5.31 and 5.37 ft respectively. Monitoring well MW-15, similar to MW-11, did not show the presence of any free product during the January 2014 sampling event.

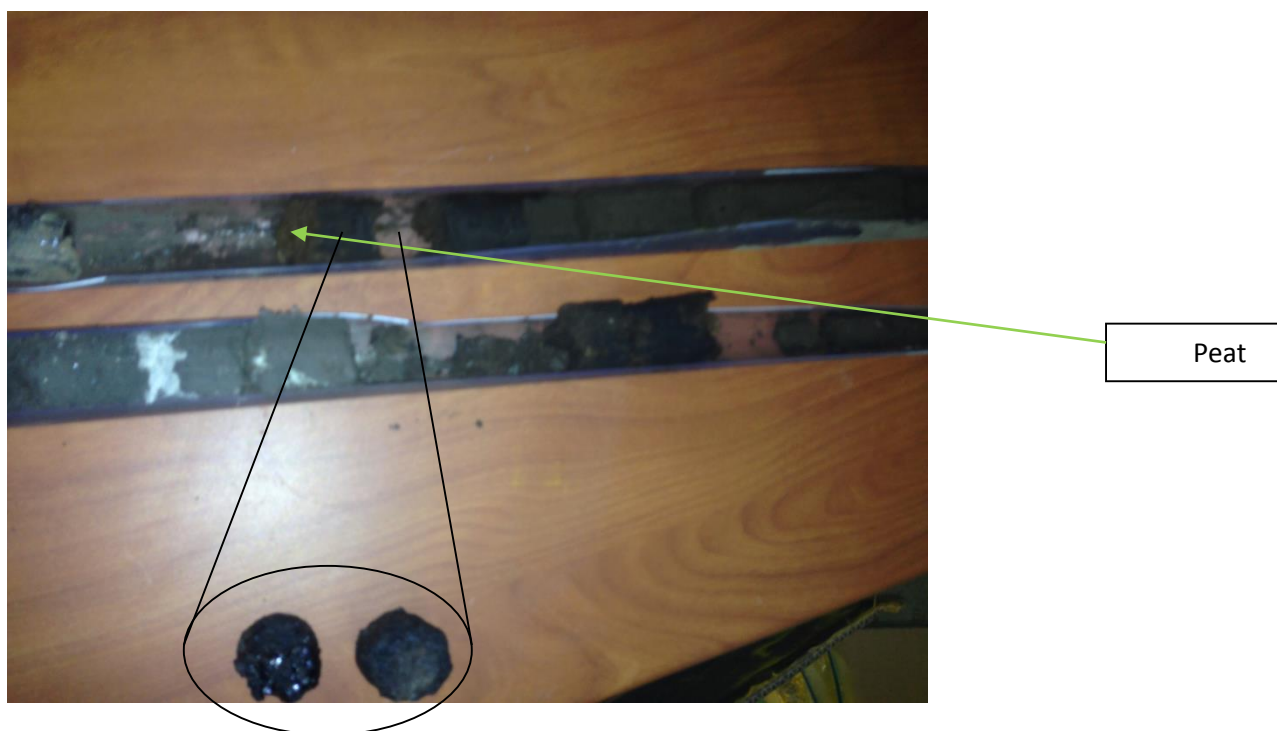
Conclusions and Recommendations

Based on the data provided, it appears that the injection of the In-Situ Geochemical Stabilization (ISGS) solution was very effective in addressing the contamination that was present on the site located in Fanwood, NJ.

The groundwater data is extremely encouraging with almost every VOC and SVOC compound either decreasing below the laboratory detection limits or recording significant concentration reductions compared to their baseline sampling values.

Furthermore the free product that was present in the ten wells that were sampled during the baseline sampling event disappeared within 30 days of the implementation of the injection event. All five monitoring wells that were sampled after the September 2013 injection event did not record any free product during the three post-injection sampling events of October 2013 (two events) and January 2014.

Two pictures of the received soil samples are presented below. It appears that following the ISGS solution injection the creosote with the strong odor that was observed above the peat layer was able to “solidify”, with no associated odor (15 days following injection). In the picture below the peat layer is easily seen and the ISGS formation immediately above it.



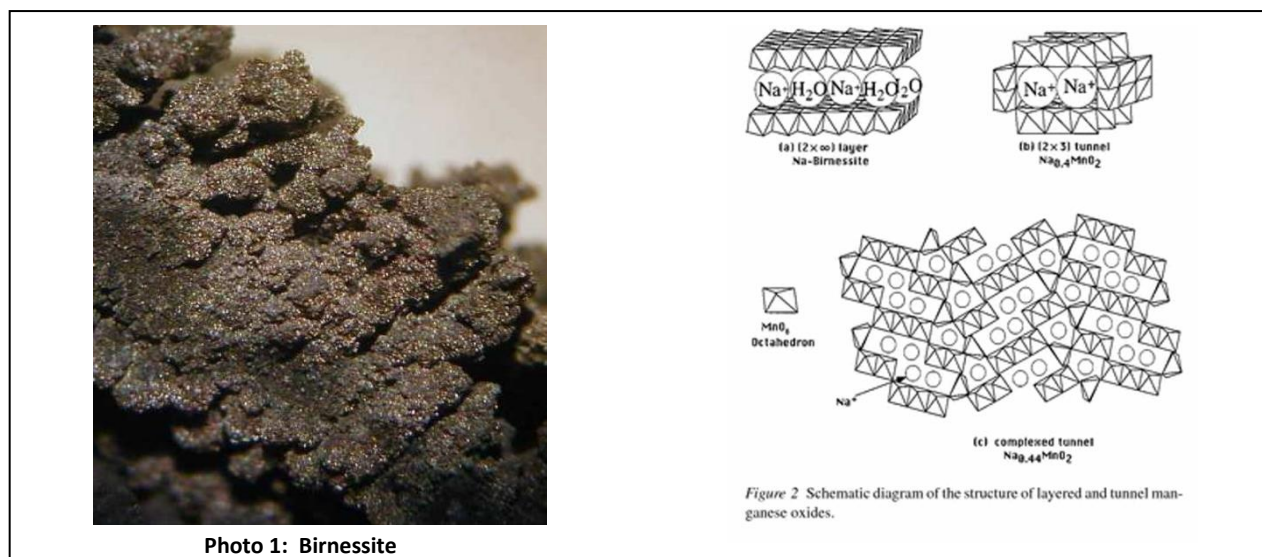
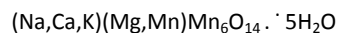


Close-up of ISGS

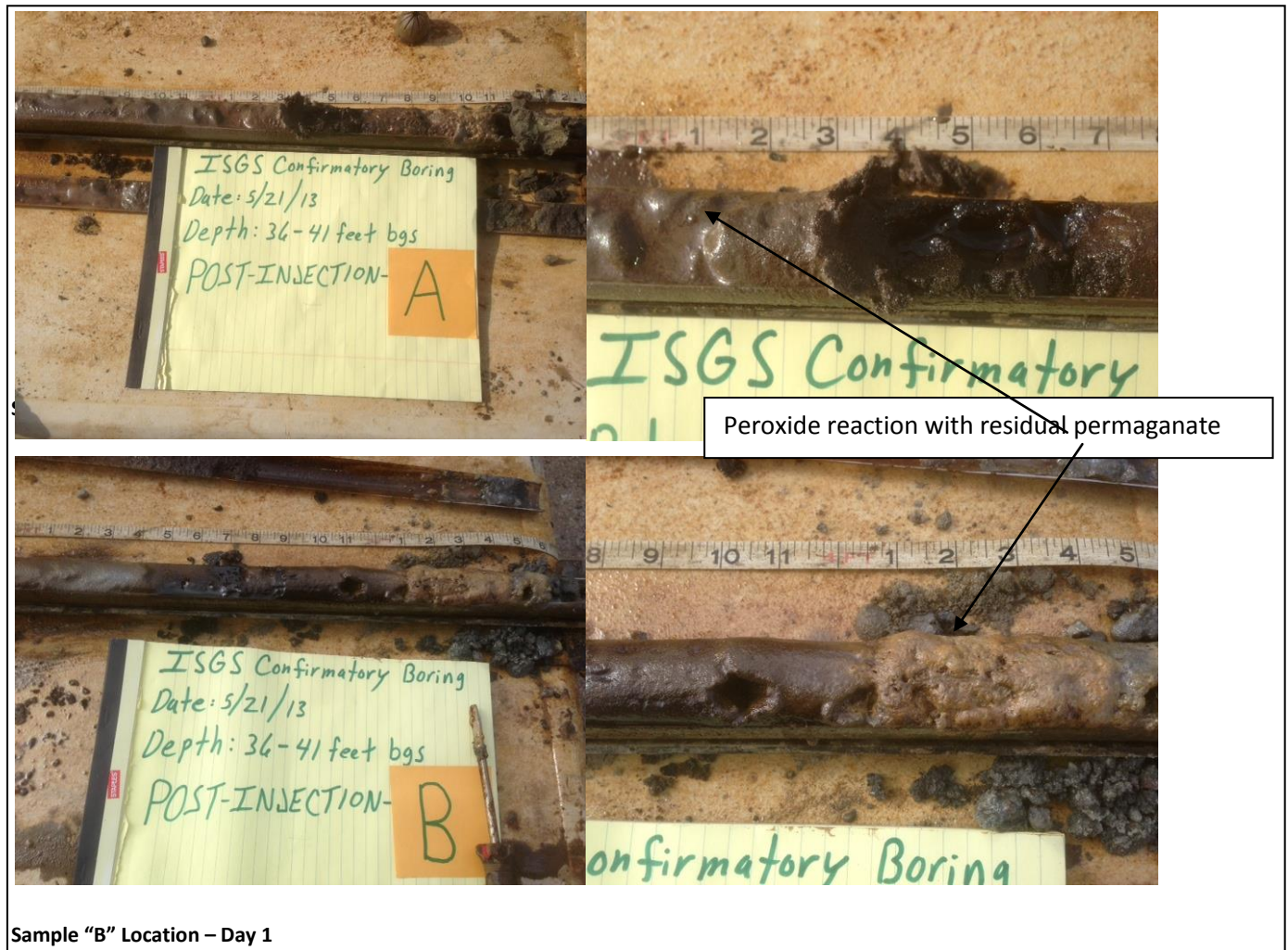
ISGS TECHNOLOGY DISCUSSION

In Situ Geochemical Stabilization (ISGS) entails the use of modified permanganate solutions for the purposes of mass removal and flux reduction (*i.e.*, NAPL stabilization). As the oxidant migrates through the treatment area, various geochemical reactions destroy the targeted compounds present in the dissolved phase. This causes a “hardening” or “chemical weathering” of the NAPL as it steadily loses its more labile components. This causes a net **increase in viscosity** of the organic material, which yields a more stable, recalcitrant residual mass. In addition, both the insoluble MnO_2 precipitate that results from permanganate oxidation and other mineral species included in the ISGS formulation accumulate along the NAPL interface, physically coating the NAPL and thereby reducing the flux of dissolved-phase constituents of interest (COI) into the groundwater as seen in the pictures below.

Summary – LNAPL Application: The primary objectives of the piloted technology are to demonstrate both mass removal and mass stabilization. To achieve these objectives the delivery of the ISGS material must effectively distribute the material to the targeted zone(s) and the formation of the Birnessite-like crust must be confirmed. Birnessite (**Photo 1**) is an oxide of Mn and Mg, along with Na, Ca and K with the composition:



The field sampling techniques one day following the injection event (traditional acetate liner advancement) proved ineffective in its ability to obtain characteristic samples below approximately 38' bgs. It was the opinion of IET that the residual hydrostatic pressure in the primary injection zone resulted in a "heaving" of the unconsolidated sands into the tooling. A consequence of this "heaving" was the inability of the acetate liner sampling tooling to overcome the hydrostatic head pressure. Samples down to 38' bgs were obtained and evaluated in the field. Photos of the day one sampling event are provided below in **Photo 2**. The day one sampling event provided evidence to support the 10' radius design basis of the pilot in the 35-38' injection zone, however without the benefit of the deeper injection zone samples a modification to the sampling technique was required. The day five sampling event utilized a discrete sampling method which allowed for the sampling of the entire injection profile (35-41' bgs). Photos of the day five sampling event are provided below in **Photo 3**.



Day One sampling occurred so as to confirm delivery and the presence of the ISGS injectant. Day Five was used to evaluate the geotechnical formation.

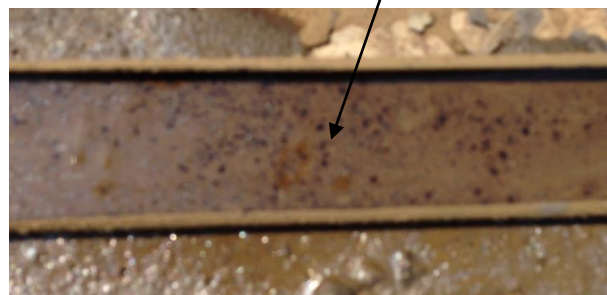
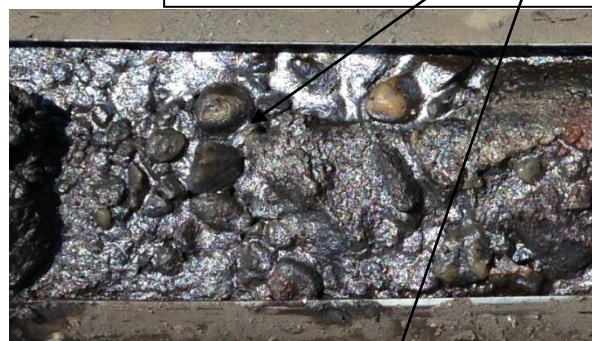


Birnessite-like crust formation around
“globels” of free-phase DNAPL and
Saturated soil



Sample “B” - Day 5 (37' bgs)

Birnessite-like crystallization Day 5



In September 2013, a creosote site was injected by IET, prior to injection creosote was seen in samples and a strong odor was noted. Following injection the creosote that was observed above the peat layer was seen to have “solidified”, with no associated odor (15 days following injection). In the picture below the peat layer is easily seen and the ISGS formation immediately above it.

